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WISC-R Short Forms for Identification of Intellectually Sub-normal Children

John Ward
Western Kentucky University

Ward,

John Gordon

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WISC-R SHORT FORMS FOR IDENTIFICATION OF INTELLECTUALLY SUB-NORMAL CHILDREN

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WISC-R SHORT FORMS

FOR IDENTIFICATION OF

INTELLECTUALLY SUB-NORMAL CHILDREN

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David A. Shirk

Director of Thesis

Robert E. Simpson

Ronald D Adams

Approved April 20 1978

Elmer Gray

Dean of Graduate College

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WISC-R SHORT FORMS

FOR IDENTIFICATION OF

INTELLECTUALLY SUB-NORMAL CHILDREN

John Gordon Ward May, 1978 59 pages

Directed by: D. Shiek, R. Adams, R. Simpson

Department of Psychology Western Kentucky University

The purpose of this study was to develop short forms of the WISC-R for use in identifying children as intellectually average or below average. The national WISC-R standardization sample and a local WISC-R generalization sample were used. Both samples were restricted to those subjects with Full Scale IQ scores less than or equal to 100. Five different development procedures were used. Three procedures used stepwise multiple regression and two procedures used multiple discriminant analysis. The short forms developed by the multiple discriminant analysis were the most accurate. The administration time per subject was reduced but scoring complexity was increased. Usable, accurate, short forms of the WISC-R are possible and practical. But, the examiner must be willing to compromise between a savings in administration time with an increase in scoring time and complexity.

Chapter 1

Introduction

The Wechsler Intelligence Scale for Children-Revised (WISC-R) belongs to a series of intelligence scales that includes the Wechsler Intelligence Scale (WAIS) and the Wechsler Preschool and Primary Scale of Intelligence (WIPPSI). The WISC-R is a revised and renormed version of its predecessor, the WISC. This series of scales was based on Wechsler's conception of intelligence as a global entity.

Wechsler (1944) advocated that intelligence was more than a single ability or measurable trait such as abstract reasoning or word knowledge. To measure intelligence one must measure more than one ability and use more than one medium, such as language. In an attempt to measure different related abilities, Wechsler used two broad classifications of subtests: verbal and performance.

The verbal subtests use a verbal request or stimulus and a verbal response. Those subtests involve computational skills, abstract reasoning, expressive vocabulary, and related areas. The performance (non-verbal) subtests use both verbal directions and non-verbal examples to describe the tasks. The subject responds primarily through actions such as; manipulating blocks to form designs, completing puzzles, copying symbols, and related activities.

The exception is the Picture Completion subtest where the subject verbally describes what is missing in each of a series of pictures depicting objects and scenes.

In addition to sampling more than one ability and one mode of responding the verbal and performance dichotomy added to the diagnostic value of the scales. Comparison between subtests and sections of the WISC-R is possible through the use of standard scores. The raw score for each subtest is converted to a standard score using tables based on the chronological age of the subject. The tables range from 6 years, 0 months, 0 days to 16 years 11 months, 30 days, in 3 months increments. After conversion of the individual subtest scores to standard scores the verbal and performance scores are respectively summed and converted to a Verbal IQ and a Performance IQ. The verbal and performance subtest's standard scores are then jointly summed together to yield one score which is converted to a Full Scale IQ.

While presenting a great deal of information about the subject a complete WISC-R is time consuming to administer, score, and interpret. The time involved can range from 45 to 90 minutes for administration with an additional 10 to 30 minutes for scoring and converting to IQ scores. The time involved depends upon the abilities of the subject, his cooperation, and the experience level of the examiner.

The saving of time is probably the most prevalent

reason for research into shortening an intelligence test. Usually the reason is assumed rather than expressed. Fisher and Shotwell (1959) stated: "The functional value of shortened measures of intelligence is obvious to anyone working in a service agency where psychodiagnosis constitutes an important part of the service: (p. 476). A more precise reason was expressed by Shwartz and Levitt (1960) in discussing the purpose of their review of short forms of the WISC: "It grew out of the need for developing short forms for quick re-evaluation of children in special classes for the mentally retarded in the Indiana public school system" (p. 187).

Levy (1968) in his review of short form development listed the major approaches used to develop short forms of the Wechsler series of intelligence scales. Four of these approaches involve the use of complete subtests and one involves reducing the number of items administered within the subtests. Briefly, the approaches are:

1) Scale sampling: Most valid subtest. One or more subtests are used that correlate highly with the Full Scale IQ.

2) Scale sampling: Most valid stratified subtest. the same process as above, but at least one scale from the verbal and one from the performance sections must be included.

3) Scale sampling: Idiosyncratic subtests. Choose subtests to avoid or represent only a certain form of

responding.

4) Factor sampling. Select scales that represent each factor from a factor analysis of the Wechsler Scales.

5) Item sampling. Reduce the number of items used in each subtest. All subtests are administered.

The scale sampling approach is the most prevalent due to the ease of acquiring data from administered complete protocols. An additional advantage is that administering an entire subtest is more similar to the experience of most examiners than skipping some items and administering others. An individual subtest can be administered in 2 to 10 minutes dependent upon the subject's ability, the examiner, and the time limits of the subtest.

The common point to the scale sampling approaches is the a priori decisions of the content of the developed short forms. Certain subtests will be selected to fit a given factor model, obtain a certain correlational level, or other plan of the researcher: These restrictions influence which subtests are included and thus the possible level of accuracy that can be obtained. A useful subtest may be ommitted or not considered because it does not fit into the structure of the researcher. In these approaches the form is primary and the results or accuracy is secondary.

More accurate short forms could be developed by minimizing restrictions and focusing upon the results or accuracy. The purpose and population with which the short

forms would be used must be decided a priori so the accuracy can be determined. With this approach short forms of the WISC-R for classification of subjects as average or below average could be developed maximizing accuracy in differentiating subjects. Subtests would be selected for inclusion in a short form based on the increase in accuracy of estimation of the Full Scale IQ of a complete WISC-R administration.

Chapter 2

Review of the Literature

Research into shortened versions of the Wechsler series of intelligence scales has occured almost since their inception. The WAIS was introduced in February, 1955. Doppelt (1956), for one, began to work then on developing a short form of the WAIS for clinical use.

Doppelt (1956) followed the lead of McNemar (1950) with the older Wechsler-Bellvue scale and used the standardization sample of the WAIS in his short form development. Doppelt chose to use four subtests as a compromise between time and accuracy of prediction. He selected the two verbal subtests and the two performance subtests that correlated highest with the total performance score.

To find the best subtests Doppelt computed the correlations for each subtest with its respective summed score for each of three age levels; 18-19, 25-34, and 45-54 years of age. That procedure resulted in the selection of the Arithmetic, Vocabulary, Block Design, and Picture Arrangement subtests. Doppelt used a regression formula where the sum of scaled scores of the four subtests was multiplied by a constant and then added to a second

constant, both supplied from tables. Doppelt obtained correlations that ranged from .960 to .954 between his short form and the complete WAIS IQ's.

Doppelt's results were confirmed by Himelstein (1957) with a sample of 61 hospitalized psychiatric patients. Himelstein obtained correlations of .954 with Doppelt's procedure.

Further confirmation of Doppelt's approach was reported by Fisher and Shotwell (1959) with 302 mentally retarded adults. However, while a correlation of .935 was obtained, they found that Doppelt's short form consistently overpredicted IQ's by two points compared to a complete WAIS administration. When two points were subtracted from each short form IQ, 78.48 percent were within 4 points and 98.02 percent were within 8 points of the IQ from a complete administration.

Following the work of Doppelt and others on the WAIS, researchers began to study the WISC. Schwartz and Levitt (1960) used a group of 177 mentally retarded children from the Indianapolis school system. Correlations between the Full Scale IQ and each subtest scale score, as well as the sum of scaled scores for every possible combination of two, three, four, five and six subtests were calculated. The researchers felt that more than six subtests would be eneconomical in time.

Schwartz and Levitt reported the five combinations of each size short form with the highest correlations with

the Full Scale IQ of a complete administration. Two interesting points of their research were that five scales were necessary to obtain correlations greater than .90 and that Doppelt's combination of subtests did not occur in the top five short form using four subtests.

A similar approach to Schwartz and Levitt was used by Enburg, Rowley, and Stone (1961) with a sample of 145 emotionally disturbed children. These researchers chose to use all possible combinations of three, four, and five subtests. They calculated the correlations between the sum of scaled scores for each short form with the total sum of scaled scores for the full test. Correlations were reported ranging from .91 to .93 for three subtests, .94 for four subtests, and .95 to .96 for five subtests combinations.

During this period in the development of short forms researchers began to question the use of correlation coefficients and standard errors of estimate based on them. From this point of view, Mumpower (1964) questioned the accuracy of developed short forms. With a short form and tables developed by Wight and Sandry (1962), Mumpower examined the results with fifty exceptional children. He obtained a correlation of .95 between the short form and a complete form of the WISC. Mumpower then classified the children according to their complete and short form IQ's into nine groups that ranged from superior to retarded custodial. He then compared the classifications made with

the complete form and the short form. He found that 11 of the 50 children were misclassified by the short form IQ despite the .95 correlation.

Kramer and Frances (1965) used a sample of 41 psychiatric patients with Doppelt's short form of the WAIS. They obtained a correlation of .94 with a complete WAIS, but the short form IQ misclassified 56 percent of the subjects using Wechsler's (1955) categories of intellectual functioning. Fifteen subtests were misclassified by one category and eight by two categories.

The finding that high correlation coefficients did not insure accuracy encouraged researchers to report a measure of accuracy, and the development of more accurate correction formulas. Silverstein (1967) reported not only the correlations between the complete form and short forms of two to five subtests, which ranged from .339 to .969, he also reported the percent of agreement between the forms. These ranged from 56.6 percent to 78.6 percent across types of short forms and age levels.

In addition to the above results Silverstein reported a modified part-whole correlation formula that he felt was more accurate in comparing short forms to complete than used previously. That resulted in additional formulas reported by several researchers; Tellegen and Briggs (1967) Silverstein (1970), and McNemar (1974), for example.

Levy (1968) brought forth several objections to the previous research on short forms. He noted that most

studies involved atypical examples such as psychiatric patients, mentally retarded subjects, or emotionally disturbed subjects. Due to the low accuracy of the short forms, and unknown reliability and validity, Levy suggested a decision-theory framework for developing short forms. He presented no concrete outline, but his concentration on the utility of the short form rather than its theoretical make-up was valuable.

Following the arguements of Levy (1968), Mumpower (1964), Silverstein (1967), and others, more complete and accurate information on short forms appeared. Resnick and Entin (1971), and Finch, Ollendick, and Ginn (1973) for example chose three criteria for their short forms of the WISC; 1) correlations between short forms and complete form IQ's should be significant, 2) t-test between the short form and complete form IQ-means should be nonsignificant, and 3) the percentage of misclassification using the short form should be as low as possible.

No research into short forms of the WISC-R was encountered in the literature. An assumption that forms developed for the WISC are equally valid for the WISC-R would be questionable. Additionally there are several problems present in the literature reviewed.

The majority of the research examined based the development solely on zero order part-whole correlation coefficient. This approach assumed that if the subtests with the highest correlations were used they would account

for the most variance in test scores. This assumption does not account for shared variance among the subtests.

A second problem area was the use of atypical samples in the development of the short forms. Many studies used samples drawn from mentally retarded, psychiatric, or strictly regional populations. A short form developed on one group may not be accurate with another.

A third problem area was the use of many a priori decisions as to the form and content of the developed short forms. Subtests were selected to match or represent factors indicated in a factor analysis of the original test in some studies. Others chose to include subtests that represented both verbal and non-verbal tasks. Both decisions included subtests regardless of their actual contribution to the accuracy of the short forms. Neither provided for extended development where several combinations would be used and compared with the same data basis.

The purpose of this study was to develop short forms of the WISC-R that would be used in screening for intellectually below average children. The classification system issued by the Commonwealth of Kentucky (Kentucky Dept. of Education, 1975) was used to define intellectually below average children as those with IQ's equal to or less than 75.

A stepwise multiple regression procedure was used, initially, in the development of the short forms. Multiple regression generates an equation that used one or more

variables to predict or estimate another variable. Stepwise multiple regression includes predictor variables in order of the increase in unique variance accounted for by their inclusion. The subtest scaled scores were regressed to the Full Scale IQ scores. This procedure allowed subtests to be included solely on potential accuracy rather than on decisions of the researcher.

The national standardization sample of the WISC-R was used in the initial developmental procedures. The use of the national standardization sample avoided the difficulties associated with small atypical samples. To cross validate the findings based on the national WISC-R standardization sample a local generalization sample was used. The use of two samples reduced the possibility of error in examining the accuracy of the developed short forms. The locally obtained generalization sample was an atypical sample and was only used with short forms already developed with the national WISC-R standardization sample.

One a priori decision was imposed for pragmatic reasons, this study used a combination of two to four subtests. Past research utilized two to six subtests in the short forms.

Following the suggestions of Jones (1962) and Levy (1968) the following utility model was used in the formation and evaluation of each short form developed:

1) As much of the original format of the WISC-R as possible would be retained and the simplest accurate scoring

procedures would be used to facilitate use.

2) Development would be based on regression techniques used with the WISC-R standardization sample.

3) Developed short forms would be evaluated according to their accuracy defined in the number and percent of misclassifications when used to estimate IQ's with the national WISC-R standardization sample and the local WISC-R generalization sample.

4) More than one development approach must be used to allow comparisons of accuracy and if possible subsequent approaches should be based on the results of the prior approaches.

Step four of the utility model was considered critical. Its purpose was to avoid overly restricting the techniques used and thus the possible range of accuracy obtainable. It also allowed for a measure of relative accuracy and for development to be focused on increased accuracy from one technique to the next.

Chapter 3

Method

Standardization Sample

The national WISC-R standardization sample was obtained to develop the short forms considered in this study. The sample consisted of 2200 subjects, 200 at each of eleven age levels that ranged from six to sixteen years of age. The original researchers balanced the sample for selected variables such as sex, race, geographical region, and socioeconomic status. A complete summary of the sample and collection procedures was reported in the WISC-R manual, (Wechsler, 1974).

Restrictions

The national WISC-R standardization sample was then restricted to subjects with Full Scale IQ's less than or equal to 100. The sample was arbitrarily restricted to gain a more conservative estimate of the accuracy of the short forms developed. A great number of cases in the higher IQ ranges would inflate the apparent accuracy of a short form by increasing the number of overall correct classifications even if many below average subjects were incorrectly classified.

The total number of subjects in the standardization

sample was reduced with the restriction. The restricted sample contained 532 males and 569 females. Full Scale IQ scores ranged from 40 to 100, with verbal IQ scores from 45 to 120, and performance IQ scores from 45 to 118.

Generalization Sample

A local sample of WISC-R protocols was obtained to form the WISC-R generalization sample. The sample was obtained to check the accuracy of the short forms developed with the restricted WISC-R standardization sample. The WISC-R generalization sample consisted of subjects administered the WISC-R by graduate psychology students as part of their clinical training at Western Kentucky University. Members of the clinical faculty of the department of psychology observed and supervised the testing.

The subjects were drawn from school systems in a three county area surrounding the University. The area contained both Urban and Rural sections. The testing period was September, 1974 to June, 1976. Table 1 contains a partial breakdown of the sample. The number of subjects at each age level ranged from seven subjects at the sixteen year old level to 135 subjects at the ten year old age level. There were 275 males and 198 females in the sample. The sample was predominately white with 241 white, 128 blacks, 21 others, and 83 subjects with no race recorded.

Procedures

Five different procedures were used in this study.

TABLE 1

Description of Local WISC-R

Generalization Sample

Chronological Age in years	Sex		Race				Classification			N
	Males	Females	White	Black	Other	Unknown	TMH	EMH	Average	
6	6	7	6	4	1	2	0	2	11	13
7	6	7	5	4	0	4	0	5	8	13
8	22	12	18	5	2	9	1	10	23	32
9	22	25	19	12	2	14	2	12	33	47
10	68	67	73	45	6	11	2	28	105	135
11	39	29	37	16	2	13	6	22	40	68
12	29	14	20	14	1	8	1	21	21	43
13	32	20	29	9	2	12	2	23	27	52
14	23	4	19	3	3	2	1	15	11	27
15	18	9	12	8	1	6	2	15	10	27
16	5	2	2	2	1	2	1	1	5	7
17	5	2	1	6	0	0	1	3	3	7
Totals	275	198	241	128	21	83	19	161	293	

Note. The following abbreviations are used: TMH = Trainable Mentally Handicapped, EMH = Educable Mentally Handicapped.

The procedures varied in techniques used, variables considered, and/or additional restrictions placed upon the restricted WISC-R standardization sample. In each procedure the restricted WISC-R standardization sample was used in the development analysis and in the initial calculations of short form IQ's. In some procedures the WISC-R generalization sample was used with the developed short forms for comparison with the results obtained on the restricted WISC-R standardization sample.

Comparisons of the short form IQ's and original or full form IQ's centered on the number of misclassifications of subjects by the short form IQ's. Misclassifications were of two types, subjects classified as average according to the short form, and the reverse. The number and percent of each type of error were examined.

Each procedure also resulted in the development of short forms of two, three, and four subtests. The number of subtests and short forms was arbitrarily chosen based on the research reviewed in the literature.

For clarity the procedures are presented in chronological order of their use. Samples, restrictions, method, and results are given with each procedure. Each procedure was entirely or partially based upon the results of the proceeding procedures.

Chapter 4

Procedure 1

Sample

The restricted WISC-R standardization sample was used in the development analysis and calculation of the short form IQ's.

Purpose

The purpose of this procedure was the initial development of multiple regression based short forms.

Method

A stepwise multiple regression procedure with the restricted WISC-R standardization sample was used to estimate Full Scale IQ's from the subtest's scaled scores. The Statistical Package for the Social Sciences, Version H (SPSSH), Subroutine Regression, (Nie, et al., 1975) was used. The stepwise multiple regression procedure included a subtest in the regression equation in order of the magnitude of additional variance accounted for by its inclusion.

The four subtests, at each age level, that accounted for the most variance (A, B, C, D) were formed into short forms of two, three, and four subtests in the order: AB, ABC, ABCD. The three short form combinations of subtests

at each age level were then regressed to the Full Scale IQ scores again with the same regression procedure as above. The initial regression equation contained weights for all twelve subtests and that also affected the constant added to the equation. Through elemination of the unused subtests a more precise equation was obtained based on the two, three, for four subtests used.

The second set of regression equations for each short form type at each age level were then used to calculate the short form IQ's with the restricted WISC-R standardization sample. The short form IQ's for each subject were compared to the original full form IQ. The number and percentage of misclassifications were then calculated.

Results

The results of the stepwise multiple regression procedure used, Procedure 1, appears in Table 2. The table contains the first six steps of the stepwise regression results. By step six the multiple correlations between the subtest scaled scores and Full Scale IQ ranged from .92543 to .96399. The range is comparable with those presented in the literature. A different pattern of subtests appeared for each age group.

The results of the short forms developed appears in Table 3 for two age groups, the six and ten year olds.

TABLE 2

Stepwise Multiple Regression With

Restricted WISC-R Standardization Sample

Age Group	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
6	PICA	BDES	SIML	ARITH	CODG	VOCAB
	.66195	.77051	.84414	.88690	.91207	.93535
		.16015	.11426	.07401	.04529	.04300
7	INFO	PICA	BDES	VOCAB	PICC	ARITH
	.67703	.81496	.86986	.90974	.93028	.94553
		.20580	.09248	.07098	.03778	.02861
8	COMP	PICC	INFO	BDES	CODG	SIML
	.56022	.69496	.81838	.86720	.89736	.92543
		.16912	.18678	.98229	.05322	.05117
9	SIML	PICC	VOCAB	BDES	CODG	OBJA
	.72996	.82085	.89110	.92044	.94892	.96229
		.14095	.12026	.06238	.04461	.02556
10	SIML	PICA	PICC	VOCAB	BDES	ARITH
	.67662	.79779	.85792	.89730	.92108	.94015
		.17865	.09957	.06912	.04324	.04870
11	INFO	BDES	VOCAB	PICA	COMP	SIML
	.68546	.83544	.90377	.93228	.94622	.95671
		.22812	.11883	.05236	.02619	.01995
12	VOCAB	BDES	PICC	SIML	CODG	PICA
	.73015	.84911	.89589	.92208	.94618	.96172
		.18786	.08164	.04761	.04502	.02964
13	VOCAB	BDES	SIML	INFO	OBJA	ARITH
	.71408	.86663	.90396	.92456	.94193	.95856
		.24113	.06611	.03766	.03242	.03161
14	VOCAB	BDES	SIML	PICC	CODG	INFO
	.74565	.85201	.88990	.92206	.94344	.96218
		.16992	.06601	.05827	.03989	.03571
15	BDES	VOCAB	PICC	ARITH	PICA	COMP
	.62000	.81940	.87308	.92043	.93464	.95081
		.28701	.09086	.08492	.02635	.03049
16	VOCAB	BDES	CODG	OBJA	PICC	ARITH
	.78519	.86491	.89924	.92750	.94381	.96399
		.13155	.06056	.05163	.03052	.03849

Note. The Order within cells is: Subtest, Multiple R, R^2 change. The following abbreviations are used: ARITH = Arithmetic, BDES = Block Design, CODG = Coding, COMP = Comprehension, INFO = Information, OBJA = Object Assembly, PICA = Picture Arrangement, PICC = Picture Completion, SIML = Similarities, VOCAB = Vocabulary.

TABLE 3

Number of Misclassifications

Stepwise Multiple Regression With

Restricted WISC-R Standardization Sample

C.A.	N BA	N A	N Total	Subtests	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
6	7	101	108	PICA, BDES	4	57.1	1	0.9	95.37
				PICA, BDES SIML	2	28.5	2	1.9	96.29
				PICA, BDES SIML, ARITH	3	42.8	3	2.9	94.44
10	9	94	103	SIML, PICA	5	55.5	0	0.0	95.14
				SIML, PICA PICC	5	55.5	0	0.0	95.14
				SIML, PICA PICC, VOCAB	4	44.4	0	0.0	96.11

Note. The following abbreviations are used: C.A.=Chronological Age, A=Average, BA=Below Average, %=percent, ARITH=Arithmetic, BDES=Block Design, PICA=Picture Arrangement, PICC=Picture Completion, SIML=Similarities, VOCAB=Vocabulary.

The results are based on the restricted WISC-R standardization sample. None of the average ten year olds were misclassified, and only one to three of the average six year olds were misclassified. However, of the nine below average ten year olds, four to five were misclassified and two to four of the below average six year olds were misclassified.

Discussion

The results indicate that one set of short forms can not be used across all age levels. Most short forms in the literature are designed to be used regardless of the age of the subject. In this study a different set of subtests appeared across age levels indicating no best set of subtests across age levels.

The results further indicated that a high correlation between subtests and Full Scale IQ does not insure accuracy. The multiple correlations for four subtests across age levels ranged from .867 to .932, when used as short forms, however, many of the below average subjects were misclassified.

In a screening instrument the concern is to differentiate average from below average subjects. A second procedure would be to stepwise multiple regress the subtest scaled scores to a category variable of below average and average.

Chapter 5

Procedure 2

Sample

The restricted WISC-R standardization sample was used in the development analysis and in calculations of the short form IQ's.

Purpose

The purpose of this procedure was to develop short forms based on regression to a category variable of average or below average. Regression to the category variable would reduce the variance present from a range of 40 to 100 on a continous scale of Full Scale IQ's to a dichotomous scale of category or classification. Classification would be the primary aim of a screening instrument for below average children.

Method

The subtest scaled scores for each age level were stepwise multiple regressed to a category variable of average below average. The categories were based on the original full form Full Scale IQ scores. The same SPSSH program and set-up was used as in Procedure 1.

The first four subtests in each regression equation were formed into combinations of two, three, and four subtests. The short form combinations at each age level

were then regressed again to the original Full Scale IQ scores to obtain the formulas for the estimated or short form classifications. The classifications based on the original full form and the short forms were then compared. The short form classifications were made with the restricted WISC-R standardization sample.

Results

The results of the stepwise multiple regression across age groups for the first six steps appears in Table 4. The multiple correlations between the subtest scaled scores and the classifications based on the original Full Scale IQ scores ranged from .60950 to .83016. This was lower than obtained in Procedure 1 when regressing to Full Scale IQ scores. A different pattern of subtests appeared across age groups compared to Procedure 1.

The results of the short forms developed appears in Table 5 for the same age groups in Table 3, the six and the ten year olds. Only one average subject was misclassified. More below average ten year olds were misclassified with Procedure 2 than Procedure 1. There was little change with the below average six year olds between Procedures 1 and 2. The majority of the below average subjects misclassified occured in the Full Scale IQ range of 70 to 75.

Discussion

Procedure 2 was overall less accurate than Procedure 1 with the below average subjects. The different patterns

TABLE 4

Stepwise Multiple Regression to Classification

With Restricted WISC-R Standardization Sample

Age Group	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
6	BDES	VOCAB	DIGIT	OBJA	PICC	CODG
	.43178	.52384	.56446	.58865	.60154	.61161
		.08798	.04420	.02790	.01534	.01220
7	PICA	ARITH	VOCAB	COMP	SIML	CODG
	.55769	.68101	.74084	.76305	.78044	.79422
		.15275	.08507	.03341	.02683	.02170
8	SIML	PICC	COMP	CODG	INFO	PICA
	.45429	.52576	.57319	.59947	.61764	.63081
		.07004	.05213	.03082	.02211	.01644
9	SIML	BDES	CODG	COMP	INFO	PICC
	.60762	.67195	.72320	.75569	.77287	.78271
		.08231	.07150	.04803	.02630	.01528
10	SIML	OBJA	CODG	ARITH	INFO	PICC
	.50671	.56708	.61547	.65576	.67858	.68965
		.06483	.05722	.05122	.03045	.01515
11	VOCAB	BDES	PICA	ARITH	COMP	CODG
	.47961	.60991	.64890	.67109	.67864	.68634
		.14196	.04908	.02929	.01019	.01051
12	SIML	PICC	CODG	COMP	PICA	ARITH
	.50899	.61614	.69533	.71967	.73152	.73675
		.12056	.10386	.03444	.01721	.00768
13	BDES	VOCAB	CODG	PICA	ARITH	OBJA
	.66341	.72586	.74268	.75859	.76885	.78298
		.08675	.02471	.02389	.01567	.02193
14	COMP	BDES	PICA	ARITH	OBJA	SIML
	.60906	.71263	.75212	.78064	.79439	.80570
		.13688	.05784	.04373	.02165	.01810
15	BDES	VOCAB	OBJA	CODG	INFO	SIML
	.41430	.52776	.56785	.58249	.60337	.60950
		.10688	.04393	.01684	.02476	.00743
16	VOCAB	BDES	PICC	ARITH	CODG	PICA
	.66033	.74601	.77787	.80918	.82130	.83016
		.12050	.04854	.04970	.01975	.01463

Note. The order within cells is: Subtest, Multiple R, R^2 change. The following abbreviations are used: ARITH=Arithmetic, BDES=Block Design, CODG=Coding, COMP=Comprehension, DIGIT=Digit Span, INFO=Information, OBJA=Object Assembly, PICA=Picture Arrangement, PICC=Picture Completion, SIML=Similarities, VOCAB=Vocabulary.

TABLE 5

Number of Misclassifications

Stepwise Multiple Regression to Classification

with Restricted WISC-R Standardization Sample

C.A.	N BA	N A	N Total	Subtests	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
6	7	101	108	BDES, VOCAB	4	57.1	0	0.0	95.37
				BDES, VOCAB, DIGIT	4	57.1	1	0.1	96.29
				BDES, VOCAB, DIGIT, OBJA	3	42.8	0	0.0	94.44
10	9	94	103	SIML, OBJA	8	88.8	0	0.0	92.23
				SIML, OBJA, CODG	8	88.8	0	0.0	92.23
				SIML, OBJA, CODG, ARITH	5	55.5	0	0.0	95.14

Note. The following abbreviations are used: C.A.=Chronological Age, BA=Below Average, A=Average, %=percent, ARITH=Arithmetic, BDES=Block Design, CODG=Coding, DIGIT=Digit Span, OBJA=Object Assembly, SIML=Similarities, VOCAB=Vocbulary,

of subtests were probably due to individual subject's patterns across subtests and to the restricted range and variance with the classification or category variable of average - below average.

One difficulty with both Procedures 1 and 2 was the regression line which passed through a point approximately equal to a Full Scale IQ of 82. Despite the restrictions of the WISC-R standardization sample to IQ's less than or equal to 100 there were more subjects in the average range than the below average range, thus the elevated regression line. Further restriction of the sample to reduce the number of average subjects would lower the regression line to pass through the borderline range of Full Scale IQ's of 70 to 80.

Chapter 6

Procedure 3

Sample

The development analysis was performed with the restricted WISC-R standardization sample. For this procedure the restricted WISC-R standardization sample was further restricted to those subjects with Full Scale IQ scores less than or equal to 80. For ease of computations only the ten year olds were used. The developed short form IQ's were calculated for both the restricted WISC-R standardization sample and the local WISC-R generalization sample of ten year olds.

Purpose

The purpose of this procedure was to lower the number of subjects in the average range so that the regression line would pass through a point closer to the dividing line between average and below average.

Method

Procedure 1 was repeated with the restricted WISC-R standardization sample further restricted to ten year olds with Full Scale IQ scores less than or equal to 80. For ease of computations only the ten year olds were used. The estimated or short form IQ scores were calculated and

compared to the original Full Scale IQ scores for the restricted WISC-R standardization sample of ten year olds and the local WISC-R generalization sample of ten year olds.

Results

The results of the stepwise multiple regression procedure appears in Table 6. A different pattern of subtests appeared again. The results of the developed short forms with both samples of ten year olds appears in Table 7. The number of misclassifications of the below average subjects was comparable with Procedures 1 and 2. There were more average subjects misclassified as below average with this procedure than by the previous procedures.

Discussion

A problem inherent in linear multiple regression used to differentiate groups was apparent. Regression treats all subjects as a homogenous group where a procedure that separates groups was needed. Instead of predicting a common denominator of the subject, Full Scale IQ scores, and then separating the groups into average or below average, the groups need to be divided first and the group differences maximized.

TABLE 6

Stepwise Multiple Regression to FSIQ's

Less Than or Equal to 80

10 Year Old Subjects

Step	Subtest	Multiple R	R^2 Change
1	Picture Arrangement	.75513	
2	Arithmetic	.84350	.14127
3	Information	.89960	.09780
4	Object Assembly	.93560	.06623
5	Picture Completion	.94720	.02167
6	Coding	.98061	.06442
7	Vocabulary	.99258	.02362
8	Digit Span	.99533	.00546
9	Block Design	.99655	.00233
10	Comprehension	.99772	.00233
11	Similarities	.99928	.00312
12	Mazes	.99932	.00006

TABLE 7

Number of Misclassifications

Stepwise Multiple Regression to FSIQ's

Less Than or Equal to 80

10 Year Old Subjects

Sample Used	Subtests	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
Restricted WISC-R Standardization	PICA, ARITH	5	55.5	7	9.5	86.40
N	PICA, ARITH, INFO	1	11.1	11	11.7	88.34
A = 7 BA = 74 Total = 103	PICA, ARITH, INFOR, OBJA	1	11.1	3	3.1	90.11
Local WISC-R Generalization	PICA, ARITH	4	13.3	10	9.5	89.62
N	PICA, ARITH, INFO	2	6.6	11	10.4	90.37
A = 30 BA = 105 Total = 135	PICA, ARITH, INFO, OBJA	3	10.0	10	9.5	90.37

Note. The following abbreviations are used: BA=Below Average, A=Average, %=Percent, ARITH=Arithmetic, INFO=Information, OBJA=Object Assembly, PICA=Picture Arrangement.

Chapter 7

Procedure 4

Sample

The restricted WISC-R standardization sample was used in the development analysis. The developed short form IQ scores were calculated for the restricted WISC-R standardization sample and the local WISC-R generalization sample.

Purpose

The purpose of this procedure was to identify average and below average subjects as two distinct groups within the sample. The pattern of subtest responses for each group could then be compared to a subject's responses as a means of deciding the subject's group membership or classification.

Method

The subjects in the restricted WISC-R standardization sample were placed into two groups. The classification of the subjects as average or below average, based on the original Full Scale IQ scores, was used to define group membership in the analysis. The subtest scaled scores were used for the common variables of the groups. A stepwise multiple discriminant analysis was used. The analysis was the SPSSH Subroutine Discriminant, Method -

MINRESID, Options 5, 7, 11, and 12. The SPSSH analysis allowed the number of steps to be set by MAXSTEPS -. That parameter was set for two subtests, then three subtests, and finally four subtests, for each age level. The SPSSH analysis yielded the formulas for calculating group membership, various tests of significance, and a count of subjects misclassified with associated percentages.

The multiple discriminant analysis generated two equations for each short form at each age level. Both equations were calculated for each subject, the products of the equations compared, and the one with the greater magnitude indicated group membership. The equations were used to calculate group memberships for the subjects in the restricted WISC-R standardization sample and the local WISC-R generalization sample.

Results

The results of the multiple discriminant analysis across age groups with the restricted WISC-R standardization sample appears in Table 8. Included in the table are the subtest combinations, the coefficients and constants for predicting group membership, and the number of subjects misclassified.

The multiple discriminant analysis was more accurate than the multiple regression procedures, based on the number of misclassifications. Table 9 contains the results of the three short forms developed used with the WISC-R generalization sample of twelve year olds, as an example.

TABLE 8

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

C.A.	Subtests	N BA	N A	N Total	Coefficients Group BA	Coefficients Group A	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
6	VOCAB	7	101	108	.91627	1.56828					
	BDES				.75572	1.58551	1	14.3	9	8.9	90.74
					-3.85609	-13.61572					
	VOCAB				.88290	1.49736					
	DIGIT				.33817	.71871					
	BDES				.71043	1.48926	1	14.3	10	9.9	89.81
					-4.42767	-16.19745					
	VOCAB				1.00310	1.67988					
	DIGIT				.32500	.69871					
	BDES				.54859	1.24350	1	14.3	11	10.9	88.89
	OBJA				.73817	1.12093					
					-6.31463	-20.54863					
7	ARITH				1.48573	2.50362					
	PICA	12	93	105	.77799	1.74606	1	8.3	7	7.5	92.38
					-5.45504	-18.69917					
	ARITH				1.47721	2.48634					
	VOCAB				1.40602	2.34994					
	PICA				.84215	1.85329	0	0	5	5.4	95.24
					-9.23549	-29.25945					
	ARITH				1.55620	2.60366					
	VOCAB				1.21808	2.07088					
	COMP				1.34226	1.99305	1	8.3	3	3.2	96.19
	PICA				.85191	1.86779					
					-12.88920	-37.31444					
8	SIML	5	95	100	.49787	1.46668					
	PICC				.80420	1.43250	1	20.0	10	10.5	89.00
					-2.70752	-12.50251					
	SIML				.38372	1.27372					
	COMP				1.00126	1.69245					
	PICC				.79574	1.41820	0	0	6	6.3	94.00
					-5.02971	-19.13745					
	SIML				.43874	1.36631					
	COMP				.93147	1.57500					
	PICC				.75484	1.34936	0	0	5	5.3	95.00
	CODG				-6.61460	-23.62607					

TABLE 8 (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

C.A.	Subtests	N			Coefficients		BA as A		A as BA		Overall
		BA	A	Total	Group BA	Group A	N	%	N	%	Correct %
9	SIML	11	84	95	.78590	1.90494					
	BDES				1.17052	1.90564	1	9.1	6	7.1	92.63
					-4.42589	-16.13829					
	SIML				.87942	2.05728					
	BDES				1.28476	2.09174					
	CODG				.96154	1.56634	0	0	6	7.1	93.68
					-7.72857	-24.90236					
	SIML				.59447	1.59656					
	COMP				1.25146	2.02347					
	BDES				1.31664	2.14329	0	0	6	7.1	93.68
	CODG				1.08237	1.76172					
					-10.67793	-32.61302					
10	SIML	9	94	103	1.07275	2.12485					
	OBJA				1.18911	1.75107	0	0	12	12.8	88.35
					-5.64030	-16.12480					
	SIML				.87801	1.83814					
	OBJA				1.50558	2.21619					
	CODG				1.08993	1.60187	0	0	8	8.5	92.23
					-9.42402	-24.29774					
	SIML				.75674	1.66510					
	ARITH				1.46692	2.09305					
	OBJA				1.67571	2.45893	0	0	6	6.4	94.17
	CODG				1.14229	1.67659					
					-14.30558	-34.23589					
11	VOCAB	9	82	91	1.15961	2.11432					
	BDES				.91631	1.67346	0	0	12	14.6	86.81
					-4.77938	-15.91219					
	VOCAB				1.11238	2.03951					
	PICA				.99383	1.49483					
	BDES				.74780	1.40658	0	0	8	9.8	91.21
					-6.95280	-21.36398					
	ARITH				1.47783	2.00749					
	VOCAB				1.04441	1.94718					
	PICA				.84719	1.36356	0	0	6	7.3	93.41
	BDES				.68117	1.31607					
					-10.88428	-28.61864					

TABLE 8 (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

C.A.	Subtests	N			Coefficients		BA as A		A as BA		Overall Correct %
		BA	A	Total	Group BA	Group A	N	%	N	%	
12	SIML	11	97	108	.90209	1.68747					
	PICC				.80402	1.56497	1	9.1	13	13.4	87.04
					-4.00055	-14.52621					
	SIML				1.09253	2.00749					
	PICC				.99720	1.88960					
	CODG				.99781	1.67678	0	0	7	7.2	93.52
					-7.75574	-25.13055					
	SIML				.77223	1.42189					
	COMP				.78270	1.43100					
	PICC				1.01968	1.93069	0	0	8	8.2	92.59
	CODG				.98105	1.64614					
					-8.83721	-28.74554					
13	VOCAB	11	92	103	1.23197	2.11498					
	BDES				1.09054	2.64647	0	0	3	3.3	97.09
					-5.11872	-20.99547					
	VOCAB				1.09520	1.89320					
	BDES				1.14305	2.73168					
	CODG				.62765	1.01836	0	0	4	4.3	96.12
					-6.66363	-25.06252					
	VOCAB				.92328	1.62729					
	PICA				.93375	1.44350					
	BDES				1.00124	2.51245	0	0	3	3.3	97.09
	CODG				.70734	1.14156					
					-8.82765	-30.23419					
14	SIML	10	86	96	.88317	1.88785					
	BDES				.82674	1.66612	0	0	8	9.3	91.67
					-3.45833	-14.91904					
	INFO				.64546	1.32689					
	SIML				.65928	1.42758					
	BDES				.84228	1.69806	0	0	7	8.1	92.71
					-4.37757	-18.80376					
	INFO				.46969	1.05584					
	SIML				.31804	.90135					
	COMP				1.32275	2.03982	0	0	7	8.1	92.71
					.83012	1.67932					
					-6.63315	-24.16774					

TABLE F (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

C.A.	Subtests	N			Coefficients		BA as A		A as BA		Overall
		BA	A	Total	Group BA	Group A	N	%	N	%	Correct %
15	VOCAB	7	89	96	1.60468	2.42882					
	BDES				1.33393	2.24562	0	0	11	12.4	88.54
					-7.90027	-19.97653					
	VOCAB				1.75418	2.68344					
	BDES				.92507	1.54928					
	OBJA				.78054	1.32934	0	0	8	9.0	91.67
					-9.21674	-23.79509					
	VOCAB				1.66550	2.56589					
	BDES				.73646	1.29928					
	OBJA				.95895	1.56583	0	0	10	11.2	89.58
	CODG				.85123	1.12830					
					-11.78841	-28.31334					
16	VOCAB	14	80	94	1.40096	2.71974					
	BDES				1.28863	2.10545	1	7.1	6	7.5	92.55
					-6.46580	-20.72859					
	VOCAB				1.44472	2.71974					
	PICC				1.00606	1.57462					
	BDES				1.05087	1.73332	1	7.1	2	2.5	96.81
					-8.79137	-26.42537					
	ARITH				1.28396	1.94569					
	VOCAB				1.34597	2.63858					
	PICC				1.44198	2.23519	1	7.1	3	3.8	95.74
	BDES				1.10007	1.80787					
					-13.73163	-37.77002					

Note. The following abbreviations are used: C.A.=Chronological Age, BA=Below Average, A=Average, %=Percent, ARITH=Arithmetic, BDES=Block Design, CODG=Coding, COMP=Comprehension, DIGIT=Digit Span, INFO=Information, OBJA=Object Assembly, PICA=Picture Arrangement, PICC=Picture Completion, SIML=Similarities, VOCAB=Vocabulary. Directions for use of Table 8 to estimate classification may be found in the Appendix.

TABLE 7

Multiple Discriminant Analysis Short Forms

With WISC-R Generalization Sample

12 Year Old Subjects

N			Subtests	BA as A		A as BA		Overall Correct %
BA	A	Total		N	%	N	%	
22	21	43	SIML, PICC	3	13.6	2	9.5	88.37
			SIML, PICC, CODG	2	9.0	2	9.5	90.69
			SIML, PICC, CODG, COMP	5	22.7	1	4.7	86.04

Note. The following abbreviations are used: BA=Below Average, A=Average, %=Percent, CODG=Coding, COMP=Comprenension, PICC=Picture Completion, SIML=Similarities.

The short forms were somewhat more accurate with the generalization sample than the restricted standardization sample for the average subjects and somewhat less accurate for the below average subjects.

Discussion

The multiple discriminant analysis was more accurate than the multiple regression procedures. However, the multiple discriminant procedure involves more complicated calculations by the examiner. Two fairly complex equations must be computed after the subtests are administered and scored. For example the classification equations for the six year olds, with a four subtest short form were:

Vocabulary x 1.00310 + Digit Span x .32500 + Block Design x .54859 + Object Assembly x .73817 - 6.31463

Vocabulary x 1.67988 + Digit Span x .69871 + Block Design x 1.24350 + Object Assembly x 1.12093 - 20.54863

Chapter 8

Procedure 5

Sample

The restricted WISC-R standardization sample was used in the development analysis. The short form IQ scores were calculated for the restricted WISC-R standardization sample and the local WISC-R generalization sample.

Purpose

The purpose of this procedure was to increase the utility of the short forms developed in Procedure 4 by reducing the computations required to establish group membership or classification.

Method

The sum of scaled scores for the combinations of two, three, and four subtests derived from Procedure 4 at each age level were calculated. The sums were then entered in the same SPSSH multiple discriminant analysis program used in Procedure 4. The stepwise option was not used and was replaced by the listwise inclusion option. The resulting equations were used to calculate the short form classifications with the restricted WISC-R standardization sample and the local generalization sample.

Results

A decrease in overall accuracy occured with Procedure

5 compared to Procedure 4. The results of Procedure 5 appears in Table 10 for all age groups of the restricted WISC-R standardization sample. With Procedure 4 none of the twelve year old below average subjects were misclassified with the four subtest short form and only eight average twelve year old subjects were misclassified. With Procedure 5 none of the below average twelve year olds were misclassified but 44 of the average subjects were misclassified.

The results of the short forms developed in Procedure 5 with the twelve year old local WISC-R generalization sample appears in Table 11. There were no significant differences between Procedures 4 and 5 with that group.

Discussion

Procedure 5 was easier to use than Procedure 4 for the examiner. The formulas for calculating the classification of a six year old with a four subtest short form developed in Procedure 5 was:

(Vocabulary + Digit Span + Block Design + Object Assembly) x .58438 - 5.50982

(Vocabulary + Digit Span + Block Design + Object Assembly) x 1.08280 - 18.91673

However, while easier to use Procedure 5 was much less accurate as indicated by the numbers of misclassification.

TABLE 10

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

Sum of Scales Approach

C.A.	Subtests	N			Coefficients		BA as A		A as BA		Overall
		BA	A	Total	Group BA	Group A	N	%	N	%	Correct %
6	BDES	7	101	108							
	VOCAB				.83501	1.57700	1	14.3	13	12.9	87.04
					-3.81717	-13.61532					
	BDES										
	VOCAB										
	DIGIT				.57385	1.11905	0	0	39	38.6	63.89
					-3.89399	-14.80805					
	BDES										
	VOCAB										
	DIGIT										
	OBJA				.58438	1.08280	0	0	56	55.4	48.15
					-5.50982	-18.91673					
7	PICA	12	93	105							
	ARITH				1.05631	2.04321	1	8.3	10	10.8	89.52
					-4.79739	-17.94952					
	PICA										
	ARITH										
	VOCAB				1.19355	2.18384	0	0	11	11.8	89.52
					-8.55373	-28.63646					
	PICA										
	ARITH										
	VOCAB										
	COMP				1.20818	2.09298	0	0	28	30.1	73.33
					-12.18249	-36.55959					
8	SIML	5	95	100							
	PICC				.65516	1.44914	1	20.0	15	15.8	84.00
					-2.55513	-12.50069					
	SIML										
	PICC										
	COMP				.70951	1.44878	0	0	30	31.6	70.00
					-4.54089	-18.93330					
	SIML										
	PICC										
	COMP										
	CODG				.69381	1.33344	0	0	54	56.8	46.00
					-6.31363	-23.32112					

TABLE 10 (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

Sum of Scales Approach

C.A.	Subtests	N BA	N A	N Total	Coefficients Group BA	Coefficients Group A	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
9	SIML	11	84	95							
	BDES				.98156	1.90530	1	9.1	5	6.0	93.68
					-4.28318	-16.13837					
	SIML										
	BDES										
	CODG				1.02956	1.84983	0	0	12	14.3	87.37
					-7.53447	-24.32309					
	SIML										
	BDES										
	CODG										
	COMP				1.04300	1.85983	0	0	26	31.0	72.63
					-10.14551	-32.25909					
10	SIML	9	94	103							
	OBJA				1.13756	1.91643	0	0	20	21.3	80.58
					-5.62462	-15.96340					
	SIML										
	OBJA										
	CODG				1.11923	1.82397	0	0	20	21.3	80.58
					-8.89162	-23.61453					
	SIML										
	OBJA										
	CODG										
	ARITH				1.19792	1.89304	0	0	30	31.9	70.87
					-13.17715	-32.90672					
11	VOCAB	9	82	91							
	BDES				1.01939	1.86024	0	0	16	19.5	82.42
					-4.70050	-15.65319					
	VOCAB										
	BDES										
	PICA				.91037	1.59347	0	0	26	31.7	71.43
					-6.77717	-20.76367					
	VOCAB										
	BDES										
	PICA										
	ARITH				.96614	1.59453	0	0	39	47.6	57.14
					-10.14448	-27.63194					

TABLE 10 (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

Sum of Scales Approach

C.A.	Subtests	N BA	N A	N Total	Coefficients Group BA	Coefficients Group A	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
12	SIML	11	97	108							
	PICC				.85232	1.62530	1	9.1	17	17.4	83.33
					-3.99040	-14.51040					
	SIML										
	PICC										
	CODG				1.02582	1.84025	0	0	24	24.7	77.78
					-7.74026	-24.90982					
	SIML										
	PICC										
	CODG										
	COMP				.87724	1.58349	0	0	44	45.4	59.26
					-8.69270	-28.32320					
13	VOCAB	11	92	103							
	BDES				1.16829	2.35430	0	0	4	4.3	96.12
					-5.09798	-20.70244					
	VOCAB										
	BDES										
	CODG				.86153	1.59049	0	0	22	23.9	78.64
					-6.22654	-21.22093					
	VOCAB										
	BDES										
	CODG										
	PICA				.86243	1.54628	0	0	43	46.7	58.25
					-8.66345	-27.84976					
14	SIML	10	86	96							
	BDES				.85307	1.76958	0	0	11	12.8	88.54
					-3.45494	-14.86651					
	SIML										
	BDES										
	INFO				.70754	1.46944	0	0	24	27.9	75.00
					-4.31601	-18.61574					
	SIML										
	BDES										
	INFO										
	COMP				.68525	1.35271	0	0	41	47.7	57.29
					-5.89313	-22.96454					

TABLE 10 (Cont.)

Multiple Discriminant Analysis With

Restricted WISC-R Standardization Sample

Sum of Scales Approach

C.A.	Subtests	N BA	N A	N Total	Coefficients Group BA	Coefficients Group A	BA as A N	BA as A %	A as BA N	A as BA %	Overall Correct %
15	VOCAB	7	89	96							
	BDES				1.45898	2.33022	0	0	9	10.1	90.63
					-7.81598	-19.93774					
	VOCAB										
	BDES										
	OBJA				.98489	1.47260	0	0	23	25.8	76.04
					-7.73840	-20.96486					
	VOCAB										
	BDES										
	OBJA										
	CODG				.94762	1.47260	0	0	45	50.6	53.13
					-10.62691	-25.66302					
16	VOCAB	14	80	94							
	BDES				1.33868	2.37913	1	7.1	7	8.8	91.49
					-6.45435	-20.38618					
	VOCAB										
	BDES										
	PICC				1.12072	1.90443	1	7.1	13	16.3	85.11
					-8.56548	-24.73380					
	VOCAB										
	BDES										
	PICC										
	ARITH				1.28460	2.11862	0	0	22	27.5	76.60
					-13.62597	-37.06265					

Note. The following abbreviations are used: C.A.=Chronological Age, BA=Below Average, A=Average, %=Percent, ARITH=Arithmetic, BDES=Block Design, CODG=Coding, COMP=Comprehension, DIGIT=Digit Span, INFO=Information, OBJA=Object Assembly, PICA=Picture Arrangement, PICC=Picture Completion, SIML=Similarities, VOCAB=Vocabulary. Directions for use of Table 10 to estimate classification may be found in the Appendix.

TABLE 11

Sum of Scales Multiple Discriminant Analysis Short Forms

With WISC-R Generalization Sample

12 Year Old Subjects

N			Subtests	BA as A		A as BA		Overall
BA	A	Total		N	%	N	%	Correct %
22	21	43	SIML, PICC	3	13.6	2	9.5	88.37
			SIML, PICC CODG	2	9.0	2	9.5	90.69
			SIML, PICC, CODG, COMP	5	22.7	1	4.7	86.04

Note: The following abbreviations are used: BA=Below Average, A=Average, %=Percent, CODG=Coding, COMP=Comprehension, PICC=Picture Completion, SIML=Similarities.

Chapter 9

Implications

It is apparent from the analyses presented in this study that there is no one best set of subtests or short form for all age groups. A different pattern of subtests appeared across age groups and analyses. The differences were probably due to idiosyncrasies of the samples used as well as the pattern of responses across subtests by individual subjects. Two subjects can obtain the same WISC-R Full Scale IQ while varying on specific subtests. If only a few subtests are administered the chances of error are greatly increased.

Although the different analyses used produced different results the multiple correlations remained high between the subtest scaled scores and Full Scale IQ. As stated earlier short forms have been developed and supported by their correlations with the Full Scale IQ. While the correlations were high, the accuracy in terms of misclassifications was low. The use of correlational approaches would appear misleading.

There appeared to be no simple solution to the development and use of an accurate short form. No one best set of subtests or short form for all age groups was found.

Relatively simple procedures did not result in very accurate short forms.

The five procedures presented in this study involve relatively complex analyses using a large, national sample. Of the five approaches, Procedure 4 was the most accurate. Procedure 4 also required the most effort on the part of the examiner. Two fairly complex equations were calculated to determine classification after the subtests are administered and scored. The use of a pocket calculator or other data processing means would increase the savings in scoring time and thus increase the utility of the short forms developed in Procedure 4.

A usable short form of the WISC-R for screening of below average children was developed. The short form developed in Procedure 4 is an example. The examiner must keep in mind the accuracy of the short form and the amount of time needed or saved by their use. There is no simple solution; but a useful, workable solution was achieved.

APPENDIX

The following directions indicate how to use the short forms developed with the multiple discriminant analysis procedures. The short forms, weights, and constants are contained in Table 8 for Procedure 4, and in Table 10 for Procedure 5.

To use Table 8:

1) Find the appropriate age in years of the subject and choose a short form of 2, 3, or 4 subtests.

2) Administer, score, and convert the raw scores to scaled scores according to the WISC-R manual.

3) Multiply each subtest scaled score by the appropriate weight given under column BA (Below Average). Add the constant given to the sum of multiplied subtest scaled scores.

4) Repeat step 3 using the weights and constant given under column A (Average).

5) Compare the results of the two equations. The more positive of the two indicates group membership or classification.

To use Table 10:

1) Follow steps 1 and 2 as listed for Table 8.

2) Sum together the subtests scaled scores and multiply the sum by the weight given under column BA (Below Average). Then add the constant given.

3) Repeat step 2 using the weight and constant given under column A (Average).

4) Compare the results of the two equations. The more positive of the two indicates group membership or classification.

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